8. Towards spatially enabled processes in SDI nodes

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Abstract

It is widely recognised that Spatial Data Infrastructures should support and facilitate the network of spatial data flows between organisations. This chapter focuses on the characteristics of the nodes in this network, which are the organisations that access, use and share spatial data to support their (business) processes. Case study research findings are presented which suggest that structural process characteristics (in terms of task division, coordination and allocation of spatial data related activities) might impact on the spatial enablement of these processes. The level of spatial enablement is considered to further affect (impede or facilitate) the related spatial data flows through the inter-organisational network.

1. Introduction

Spatial Data Infrastructure (SDI) is a complex concept with many facets, but essentially SDIs are about facilitating and coordinating spatial information flows (Masser, 2005). Chapter 2 of this book presented a network perspective of SDI, which implies that the objectives of an SDI are achieved in terms of multiple organisations that access, use or disseminate spatial data, and in terms of the flows of spatial data between those organisations in order to support their different business processes (hereinafter referred to as 'processes'). Together, they form a network of spatial data flows. The SDI can be seen as the whole of measures or initiatives that are intended to shape this network. Impedance was defined as a measure of opposition to spatial data flow through the network. Chapter 3 argued that the analysis of these spatial information flows should not be separated from the processes in which they are embedded.

A network perspective assumes that in order to explain a given social phenomenon, both the characteristics of the nodes and their mutual relations need to be considered (Granovetter, 1973). This chapter focuses on the characteristics of the nodes, i.e. the organisations that access, use and share spatial data in the context of their processes. The chapter attempts to show that the structure of the process within these nodes may impact on the process's spatial enablement (2007; Dessers et al., 2010), which is considered to further affect (impede or facilitate) the related spatial data flow through the inter-organisational network.

2. Process structures and spatial information handling

Organising a process involves providing the conditions for the process to reach its goals (i.e. products and services meeting the needs of their users and society at large). Among these conditions, the way tasks or process steps are identified, grouped and coordinated plays a primordial role (de Sitter, 2000; Simons, 2005; Dessers et al., 2010). The implied task division results in (1) a production structure and (2) a control (or coordination) structure (de Sitter et al., 1997). Coordination

mechanisms can be considered as the glue holding the division of labour – the production structure – together (Mintzberg, 1993). As Figure 1 shows, the production structure can be defined as the architecture of grouping and linking the executing tasks of production, preparation and support in relation with the process flow. The control structure can be defined as the architecture of grouping and linking coordination and steering activities (de Sitter, 2000).

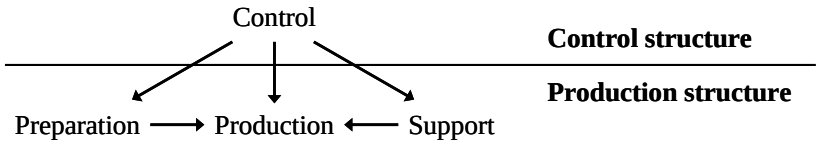

Figure 1. The control structure and the production structure (Adapted from: Van Hootegem, 2000)

The concepts of production structure and control structure can be applied at various levels, ranging from a production unit, a department, an entire organization, a network of organisations to a complete business sector (de Sitter, 2000). In this book, the focus is on individual processes, which were defined in chapter 3 as series of interrelated activities that turn an input of resources into an output of products or services. A process structure can then be defined as the sum total of the production structure and the control structure of an individual process. In other words, a process structure refers to the whole of the ways in which (1) a composite task (the production of a good or service) is divided into distinct tasks and (2) the coordination is achieved among these tasks. (This definition is analogous to Mintzberg's definition of organizational structure (Mintzberg, 1993), referring to the control structure and the production structure of an entire organisation.)

A fundamental characteristic of the production structure of a process concerns whether the process is divided into specialised tasks that are allocated to separate organisational units, or conversely, whether the execution of the process is entirely in the hands of the same organisational unit. (1) A function-based task division comes about when similar or related activities are brought together in one organisational unit. The process follows lines between the units. The grouping criterion concerns input for processes. (2) A process-based task division builds on similarity in output as the basis for grouping activities. All activities related to a product or service (or a related group of products or services), for example defined by the fact that these serve a certain type of customer or a certain regional market, are brought together in one organisational unit. The processes are assembled in parallel, heterogeneous and relatively autonomous subsystems (Van Hootegem, 2000).

With regard to the linkage between the production structure and the control structure, again two basic alternatives are possible (Van Hootegem, 2000; Daft, 2001). (1) The coordination function can be separated from the productive, preparative and support functions. The coordination capacity is then situated at a management level, away from the operational work, resulting in a centralised control structure. (2) If, on the contrary, the coordination function is integrated in the production structure, a de-centralised control structure is created.

External demands are relevant factors for assessing the effectiveness of process structures (Henderson & Venkatraman, 1999). The external demands influence the amount of coordination needed to make the process perform well (Daft, 2001). For better understanding the connections between external demands on organizations and their internal production and control structures,

the Modern Socio-Technical Systems (MSTS) approach offers a useful framework. The MSTS-framework for analysis and design of processes and organisations (van Eijnatten, 1993; de Sitter, 2000; van Amelsvoort, 2000) is based on cybernetics (Ashby, 1957) and social systems theory (Luhmann, 1984). MSTS argues that the function of the production structure and the control structure is to create the necessary and boundary conditions to meet the environmental demands. Based on Ashby's law of requisite variety (Ashby, 1957) MSTS states that the coordinating capacity of an organisational unit should be in proportion to its coordinating needs. A function-based task division can be very effective in dealing with efficiency and quality demands, because internal efficiency of every process step can be maximised. When processes are running stable and routine, the coordination needs in the production structure are usually limited, because the routine tasks can be standardised and allow central coordination (Daft, 2001). However, when the environment becomes more dynamic, and flexibility and innovation gain importance, the processes should enable swift reactions to environmental changes. The needs for coordination increase. A function-based organisational structure is likely to have difficulty in meeting these needs. On the one hand, each unit only controls a very small step in the entire process. On the other hand, every unit has to deal with many processes, and their connected demands. Processes that are organised in a more process-oriented way run parallel with each other, and cause less interference. Dividing the work in logically connected streams could minimise coordination problems (Van Hootegem et al., 2008).

The social and economic environment in which organisations operate has undergone a major evolution, which can be characterised by (1) a growing level of uncertainty (Daft, 2001; Van Hootegem et al., 2008) causing the environment to become more complex to handle (Exton & Totterdill, 2007), and (2) a rising level of dependence on external resources, leading to a growing network of interdependencies between organisations. Especially the streams of information become ever greater, both in number and size. The use and exchange of information has become increasingly important in contemporary society (Castells & Himanen, 2002; Roche & Caron, 2004). These flows often have a spatial component (Longhorn & Blakemore, 2008). The growing importance of (spatial) information itself raises the need for mutual alignment and cooperation, both between and within organisations (Campbell & Masser, 1995; Omran & Van Etten, 2007). At the same time, SDI initiatives are introduced to support organisations and their processes in dealing with external demands (Rajabifard et al., 2002). As a result of this evolution, processes are confronted with increasing demands for flexibility and innovation (Bolwijn & Kumpe, 1991; Van Hootegem et al., 2008). They are becoming less predictable, routine and transparent. Changes in technology, markets, regulation, global politics, the environment, demographics, and the expectations of customers and employees place adaptability at a premium (Exton & Totterdill, 2007). Based on the argument developed above, we assume that process structures could be important factors influencing the level of integration of spatial information. Processes are defined as spatially enabled, when there is a high performing integration of spatial information flows in these processes (Dessers et al., 2010). A more elaborated account of how different structures relate to process and organisational performance, and how spatial information flows are to fit in these, can be found in (Dessers et al., 2011c).

In the next part of this chapter we present the results of a case study on the possible impact of process structure characteristics on the spatial enablement of the process.

3. Empirical research

In this part we describe the research design, explain how the concept of the process structure is operationalized, and present the research findings.

3.1 Research design

We chose to pursue a case study research design in order to answer the research question. Case-based research is a widely used method for studying complex contemporary phenomena in their actual context (Yin, 2003). Since this research aims to assess how and why differences in operational process structures impact on the integration of spatial information within those processes, the case study seems to be an appropriate research method (Dessers et al., 2011b). The case study is focused on the public sector in the region of Flanders (Belgium). The case corresponds to the unit of analysis, which is defined as a process in which spatial data are accessed, used and distributed. Four cases were selected: the development of zoning plans; the management of traffic accident registrations; the management of address data; and the mapping of flood areas. Within each case, a further selection was made of five to eight organisations. A more detailed description of the four cases and the selected organisations can be found in Chapter 3.

The four processes and their organisations were selected because of the expected variety in process structure characteristics, since the selection should allow the examination of the relation between process structure and spatial enablement. The selection was based on information from exploratory interviews and discussions with key stakeholders, consultation of various documents (such as brochures and annual reports) and survey results (Crompvoets et al., 2009; Callens, 2008). During the case study information was gathered by way of multiple in-depth interviews in each organisation, with process owners, GIS operators, team leaders, organisational experts, managers, GIS coordinators, legal experts, ICT managers and database experts.

3.2 Operationalisation of the concepts spatial enablement and process structure

The research question encompasses two central concepts: *process structure* and *spatial enablement*. The concept of *spatial enablement* refers to the extent to which access, use and sharing of information is an integrated part of the process, and to the extent to which this information handling supports the overall process objectives. Table 1 presents an overview of the various spatial enablement variables and sub-variables. First, the sub-variables *efficiency of access*, *intensity of use* and *degree of sharing* are aggregated into the variable *spatial data integration*. Second, the sub-variables (contribution to) *efficiency and quality*, *flexibility and innovation*, and *transparency and reliability*, are aggregated into the *contribution to process performance* variable. Finally, these two total values are compared, and aggregated into one overall *spatial enablement* value per intra-organisational process. For a more extensive argumentation on the operationalisation and on the actual assessment methodology, see (Vandenbroucke et al., 2011).

Table 1: Spatial enablement: Variables and sub-variables

	Variable	Sub-variable
SPATIAL ENABLEMENT	Spatial data integration	Efficiency of access Intensity of use Degree of sharing
	Contribution to process performance	Efficiency and Quality Flexibility and Innovation Transparency and Reliability

The *process structure* concept relates to the task division (production structure) and coordination (control structure) in the part of the process for which the organisation in question is responsible, including any outsourcing of activities. The concept is formulated into three variables: (1) *task division*; (2) *coordination*; and (3) *spatial data function*. Table 2 presents an overview of the various *process structure* variables and sub-variables.

The variable *task division* is further composed of two sub-variables. The first sub-variable is *internal task division*, which refers to the allocation of the process steps within the organisation, including production, preparation and support activities. In other words, it is the extent to which the different steps in the execution of the process are functionally distributed across various departments. The second sub-variable is *outsourcing*, which refers to the scope and the frequency of contracting out process steps. Based on these two sub-variables, an assessment is made of the degree to which the process execution is fragmented across various organisational units.

The concept of *process structure* relates not just to task allocation, but also to the coordination and control of these allocated tasks. The variable *coordination* refers to the management and control of the in-house and outsourced process tasks. This variable describes the level of centralisation varying from centralised, meaning that the coordination and control of the process is exercised entirely at the management level, to de-centralised, meaning that the coordination and control is largely integrated in the process.

As this research specifically focuses on the role of spatial data, the extent to which the activities of collecting, using and distributing spatial data are integrated in the process is separately assessed. It should be clear that the variable *spatial data function* is different from *spatial enablement*. While *spatial data function* refers to the position of (possible) spatial data related activities with regard to the other process activities, spatial enablement is about the level of actual integration of spatial data (acces, use and sharing) in the various process steps, and the subsequent contribution to process performance. Whether concentrating spatial data related process tasks in a specialised GIS unit offers the best chances for a high level of spatial enablement, or conversely, de-concentrating them to the teams responsible for the process tasks, is a question that many organisation struggle with (Reeve & Petch, 1999). Therefore the relation between both variables is made part of the research question. The variable is composed of two sub-variables. The first sub-variable is the *allocation* of the spatial data function, which refers to the level of separation of the spatial data related activities from the other process activities. The spatial data function can be concentrated in a central GIS unit, or in a drawing office at the departmental level. Conversely, these activities can be allocated at the team

that runs the process. The second sub-variable is the *strength* of the spatial data function, referring to the level of GIS knowledge and know-how within the unit to which the spatial related activities in the process are allocated. Based on these two sub-variables, an assessment is made of the degree to which the spatial data related activities are separated from the organizational units that perform the other process activities.

Table 2: Process structure: Variables and sub-variables

	Variable	**Sub-variable**
PROCESS STRUCTURE	Task division	Internal task division Outsourcing
	Coordination	
	Spatial data function	Allocation Strength

3.3 Assessment of the variable values

The following method is used to assess the variable values. First, a description is made of the status of the organizations for each of the (sub-)variables, based on the interview transcripts and the collected documents (organization charts, annual reports etc.). Second, for each (sub-)variable the organisations are positioned on a five-point scale (low, medium/low, medium, medium/high, high) by the authors. In case the values are attributed to sub-variables, they are further aggregated into a total value for the variable involved. It should be noted that the qualitative scale is applied as a tool to structure the data, in order to facilitate the comparative analysis. Caution must be applied when interpreting the values without reference to the underlying qualitative descriptions and argumentation.

Within the scope of this chapter we provide an example of how such descriptions of process characteristics are translated into variable values. A detailed explanation of the methodology and of the results for each case can be found in the case study reports (Dessers et al., 2011a; Dessers et al., 2011d). As can be seen from Table 3, the Department of Spatial Planning, Housing and Immovable Heritage of the Flemish Government (RWO) has the lowest value for *task division*, while the provincial administration of Limburg has the highest value. These values are the result of a combination of two sub-variables: *internal task division* and (level of) *outsourcing*. RWO's Spatial Planning section is organised in dynamic clusters, with highly versatile spatial planners. Furthermore, supportive and preparative features, like legal aspects, GIS coordination or organisation reform, are added to the tasks the spatial planners. Moreover, all zoning plans are entirely developed in-house. This description eventually results in a low value for *task division*, since all steps in the development of a specific zoning plan are allocated in full to one of the polyvalent spatial planners. In Limburg, the spatial planners are divided into two separate units, of which only one unit is responsible for developing zoning plans (while the other one specializes in evaluating and advising municipal zoning plans). Furthermore, the spatial planners are highly specialized in specific spatial planning themes (living, work, rural areas, tourism, recreation, line infrastructures). In general, all aspects of content and graphic design of spatial zoning plans are outsourced to consulting firms, while the provincial spatial planners are mainly engaged in procedural aspects and control. This description eventually

results in a high value for *task division*, since, first, the zoning planning procedures themselves are allocated to thematically focused spatial planners, and second, the different steps in the development of a specific zoning plan are fragmented between external parties, spatial planners and support departments (e.g. for legal aspects). The other four organisations in the Zoning Plans case are situated somewhere between RWO and Limburg, based on the descriptions of their *task division*.

3.3 Research findings

Within each of the four cases, selected organisations were compared to study the possible impact of process structures on the integration of spatial data in the process within each organisation. A detailed description of the methodology and the results for each case can be found in the case study reports (Dessers et al., 2011a; Dessers et al., 2011d).

3.4.1 The Zoning Plans case

The development of zoning plans is the first of four processes which are selected as cases in this research. A zoning plan defines regulations with regard to zoning, development and management of a certain area at the parcel level. Within this case, a further selection of six organisations was made, in which information was gathered by way of in-depth interviews: the regional cities of Genk, Kortrijk and Leuven, the provinces of Limburg and West-Vlaanderen, and the Department of Spatial Planning, Housing and Immovable Heritage (RWO) of the Flemish Government.

It is apparent that each organisation has nearly the same values on the three variables *task division*, *coordination* and *spatial data function*. The similarity between *task division* and *coordination* seems to indicate that the higher the extent to which the different steps in the execution of the spatial zoning process are functionally distributed across various departments, the higher the level of centralised coordination of the various process steps. This finding accords with the theory-based expectation that high levels of fragmentation imply the need for a centralised control.

The three variables *task division*, *coordination* and *spatial data function* (negatively) relate to *spatial enablement*. This finding seems to suggest that the presence of an integrated (as opposed to fragmented) process, with a de-centralised coordination and an embedded spatial data function could be related to a higher level of spatial enablement. In four organisations (RWO, Limburg, West-Vlaanderen and Leuven) the match between the three variables and spatial enablement is nearly perfect, while the two other organisations show only a small deviation. The observed relation seems to confirm the hypothesis, which stated that spatial enablement is likely to be higher when a process-based task division is combined with a de-centralised control structure.

To conclude, there seems to be a relation between *task division*, *coordination* and *spatial data function* on the one hand, and the *spatial enablement* variable on the other hand.

Table 2. The Zoning plans Case

	Task division	Coordination	Spatial data function	**SPATIAL ENABLEMENT**
RWO	Low	Low	Low	**HIGH**
West-Vlaanderen	Medium / Low	Low	Low	**HIGH**
Genk	Medium / High	Medium / High	Medium / High	**MEDIUM**
Leuven	Medium	Medium	Medium	**MEDIUM**
Kortrijk	Medium	Medium / Low	Medium	**MEDIUM / LOW**
Limburg	High	High	Medium / High	**LOW**

3.4.2 The Addresses case

The management of addresses is the second process that was selected as a case in this research. Within this case, a further selection of five organisations was made: the regional cities of Leuven and Mechelen, the municipality of Zwijndrecht, and the provinces of Antwerpen and West-Vlaanderen. Address management was investigated as a supportive process within three other processes: population registration, environmental permit delivery and economic policy making.

Since the *task division* variable reveals no differences between the organisations, this variable could not be used for explaining the level of *spatial enablement.* All organisations show a medium/low level of *task division*, indicating that, in all these organisations, the address management is to a large extent embedded in the supported processes of the three departments studied. It should be noted that the variable *task division* describes the location of the supportive address management (sub-) process with regard to a selection of other (production) processes, like population registration. Possible differences concerning the internal structure of these supported processes were not part of the study.

The variable *coordination* then refers to the extent to which these embedded address management activities are coordinated at the organisational level. It is apparent that Leuven, which has the highest level of *spatial enablement*, also has the highest level of *coordination*. This may indicate that a de-concentrated *task division* may require a certain level of central coordination in order to reach a high level of *spatial enablement*. However, the relation between the variable *coordination* and *spatial enablement* could not be confirmed for the other four organisations.

The variable *spatial data function* (negatively) correlates with the *spatial enablement* variable. For Zwijndrecht and Antwerpen, a high value for the *spatial data function* variable can be linked to a low level of *spatial enablement*. Conversely, for Leuven and West-Vlaanderen, a (medium/) low value for the *spatial data function* variable can be linked to a (medium/) high level of *spatial enablement*. Mechelen has a medium value for both variables. The observed relation seems to confirm the hypothesis, which stated that *spatial enablement* is likely to be higher when the *spatial data function* is integrated in the process.

To conclude, there seems to be a relation between *spatial data function* on the one hand, and the *spatial enablement* variables on the other hand. Indications were found that a high level of central *coordination* of de-concentrated address management could contribute to the *spatial enablement* of the address management process.

Table 3. The Addresses Case

	Task division	Coordination	Spatial data function	**SPATIAL ENABLEMENT**
Leuven	Medium / Low	High	Medium / Low	**HIGH**
West-Vlaanderen	Medium / Low	Medium	Low	**MEDIUM / HIGH**
Mechelen	Medium / Low	Low	Medium	**MEDIUM**
Antwerpen	Medium / Low	Medium	High	**LOW**
Zwijndrecht	Medium / Low	Low	High	**LOW**

3.4.3 The Traffic Accidents case

The registration of traffic accidents, and the further collection, processing and distribution of these registrations is the third case in this research. Within this case, a further selection of eight organisations was made: three local police zones (PZ Het Houtsche, PZ VLAS and PZ Leuven), the Federal Police, the national statistics agency (ADSEI), the regional Mobility and Public Works Department (MOW) and the two provinces Vlaams-Brabant and West-Vlaanderen.

The variable *task division* (negatively) relates to *spatial enablement*. West-Vlaanderen and PZ Het Houtsche combine the highest level of *spatial enablement* with a low level of *task division*. Vlaams-Brabant, PZ Leuven and PZ VLAS have a medium level of *spatial enablement*, and a (medium /) low level of *task division*. And finally, Federal Police, ADSEI and MOW have a (medium/)low level of *spatial enablement*, and the highest (i.e. medium) level of *task division*. The relation between *coordination* and *spatial data function* on the one hand, and *spatial enablement* on the other hand, is somewhat less straightforward, although the general tendencies seem to prevail. The variables show equivalent values, or values that only differ one unit (e.g. medium and medium/low). These findings seems to suggest that the presence of an integrated (as opposed to fragmented) process with an embedded spatial data function could be related to a higher level of *spatial enablement*. The observed relation seems to confirm the hypothesis, which stated that the level of *spatial enablement* is likely to be higher when a process-based task division is combined with a de-centralised control structure.

To conclude, there seems to be a relation between *task division*, *coordination* and *spatial data function* on the one hand, and the *spatial enablement* variables on the other hand.

Table 4. The Traffic Accidents Case

	Task division	Coordination	Spatial data function	**SPATIAL ENABLEMENT**
PZ Het Houtsche	Low	Medium	Medium	**MEDIUM / HIGH**
West-Vlaanderen	Low	Medium / Low	Medium / Low	**MEDIUM / HIGH**
PZ Leuven	Medium / Low	Medium / High	Medium	**MEDIUM**
PZ VLAS	Low	Medium / High	Medium	**MEDIUM**
Vlaams-Brabant	Medium / Low	Medium / Low	Medium / Low	**MEDIUM**
Federal Police	Medium	Medium / High	Medium / High	**MEDIUM / LOW**
MOW	Medium	Medium	Medium	**MEDIUM / LOW**
ADSEI	Medium	Medium / High	/	**LOW**

3.4.4 The Flood Maps case

The creation and application of flood maps is the fourth case in this research. Within this case, a further selection of six organisations was made: the city of Leuven, the St.-Truiden Water Board, the provinces of Limburg and Vlaams-Brabant, and two regional agencies (the Flemish Environment Agency and Flanders Hydraulics Research).

The variable *task division* seems to (negatively) relate to *spatial enablement.* The medium/low levels of *task division* of the Flemish Environment Agency, Limburg and the St.-Truiden Water Board relate to a high level of *spatial enablement*, and the medium level of *task division* of Flanders Hydraulics Research and Vlaams-Brabant relates to a medium(/high) level of *spatial enablement*. Leuven combines a medium/high value on *task division* with a low value on *spatial enablement*. A similar relation was found between spatial data function and *spatial enablement,* in which a (medium/) low level of separation of the *spatial data function* could be linked to a (medium/)high level of *spatial enablement.* A medium level of separation of the *spatial data function* seems to lead to a medium or low level of *spatial enablement.* These findings again seems to suggest that the presence of an integrated (as opposed to fragmented) process with an embedded spatial data function could be related to a higher level of *spatial enablement*.

As for the *coordination* variable, a similar (negative) relation was found with *spatial enablement*, suggesting that a more de-centralised control structure might lead to a higher level of *spatial enablement*. However, the Flemish Environment Agency deviates from the general tendency, by combining a medium/high value on *coordination* with a high value on *spatial enablement.*

To conclude, there seems to be a relation between the *task division, coordination,* and *spatial data function* on the one hand, and the *spatial enablement* variable on the other hand.

Table 5. The Flood Maps Case

	Task division	Coordination	Spatial data function	**SPATIAL ENABLEMENT**
Flemish Environment Agency	Medium / Low	Medium / High	Medium / Low	**HIGH**
Limburg	Medium / Low	Medium / Low	Low	**HIGH**
St.-Truiden Water Board	Medium / Low	Low	Low	**HIGH**
Flanders Hydraulics Research	Medium	Medium / Low	Medium / Low	**MEDIUM / HIGH**
Vlaams-Brabant	Medium	Medium	Medium	**MEDIUM**
Leuven	Medium / High	Medium / High	Medium	**LOW**

4. Discussion

It is interesting to note that in all four cases of this study the *process structure* variables seem to be of importance for explaining the level of *spatial enablement* of the process. These findings suggest that keeping the (main part of the) process from A to Z together by allocating the full set of process activities to a single organizational unit could improve the spatial enablement of the process. This

task division implies that not only the production functions, but also the process-related support and preparative functions are largely integrated in the process. Furthermore, also to the *coordination* and control of these allocated tasks are then largely integrated in the process. It should however be noted that a limited, but material level of central coordination and support seems to be necessary. A de-concentrated process seems to require a certain level of central coordination in order to reach a high level of spatial enablement.

The findings of all four cases also suggest that embedding the *spatial data function* is related to higher levels of *spatial enablement* of the process. Embedding the *spatial data function* refers to the allocation of sufficient spatial data related knowledge and skills in the hands of the people who are involved in the process. Again, a de-concentrated *spatial data function* does not equal leaving the departments to muddle on their own. A certain level of central coordination and support might be needed to reach a high level of *spatial enablement*. It should be noted that the presence of a dedicated GIS expert in the organisational unit involved often seems to be a successful way of providing the necessary support at the process level.

It is also apparent that organisations often have similar values on the variables *task division* and *spatial data function*. Although this similarity may be explained in part by a certain overlap between the two variables (since the allocation of the *spatial data function* is evidently also part of the overall *task division*), it may indicate that the allocation of the *spatial data function* depends to a considerable extent on the way the various functions are allocated in the process.

Thus, the presence of an integrated (as opposed to fragmented) process with an embedded spatial data function seems to be related to a higher level of spatial enablement of the process. Although no previous research has been found that systematically surveyed the connection between process structure and spatial enablement, this study produced results which corroborate certain findings of previous work in this field. Nedovic-Budic (1997) provided case study results as evidence of an impact of organisational contextual factors on GIS initiation and implementation. Harvey and Tulloch (2006) presented research findings which suggest that the effectiveness of an SDI depends on the uptake of spatial data use and sharing by government organisations in support of their activities. The research by Chan and Williamson (1999) on the link between SDI and corporate GIS stressed the importance of business requirements for SDI development. Reed (2004) found that the use of standards and interoperable architectures are secondary to an understanding of a given business process and how geospatial data and services can best be used. The study by Roche et al. (2003) found that the social utility value of spatial information technology was quite low compared with the quantitative level at which they are diffused. Their findings suggest that the low social utility value was due to organizational and institutional barriers, and more specifically to the lack of interpenetration with the organisational processes. Based on organisational change literature, Pornon (2004) stresses the importance of a system approach to GIS implementation, encompassing integration and diversification of business flows, and a primary emphasis on the significance of information for the business processes. Furthermore, only a few studies take the viewpoint of an application field to assess SDI performance, like poverty management (Akinyemi, 2007) or local planning (Nedovic-Budic et al., 2004). Some indications were found in previous research of a possible connection between process structures and spatial enablement. Omran and Van Etten (2007) found that a hierarchical organisation structure could put serious constraints to spatial data sharing. The research of Vonk et al. (2007) showed that learning organizations are more likely to find, appreciate, adopt, and

implement geo-information technologies than classic top-down organizations, and stressed the need to bring technical knowledge and process knowledge together within the various processes of an organization. Campbell and Masser (1995) found that the highly departmental structure of local governments, which often implied an absence of a culture of collaboration, could pose severe problems for the development and implementation of a GIS within the organisation. The present study provides additional evidence with respect to the possible link between process structure characteristics and their spatial enablement.

It should be noted that the options for keeping the process steps together in a single organisational unit may be limited by the structure of the inter-organisational process, which refers to the task division and coordination between the nodes, as discussed in Chapter 3. This can be illustrated by the traffic accidents case, in which each node only performs a limited part of an inter-organisational process chain. The spatial enablement of the process may therefore (partly) depend on the inter-organisational process structure. However, the possible impact of inter-organisational process characteristics is not treated in this chapter. Finally, as mentioned in Section 2, the demands that are made on the process might impact the relation between process structure and spatial enablement. A detailed analysis of various external and internal demands on the processes can be found in the case reports.

5. Conclusion

Spatially enabling the processes within the organisational nodes is expected to facilitate the flow of spatial data in the SDI network. The results of the case studies seem to support the hypothesis that an integrated (as opposed to fragmented) process structure with an embedded spatial data function could be linked to a high performing integration of spatial information in the process. It is recommended that further research be undertaken in the following areas: (1) The application of the proposed research methodology to other processes in other (international) contexts could provide more insight in the relation between process structures and spatial enablement. (2) A longitudinal approach could provide better insight in the dynamic aspects of process structures and spatial enablement.

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